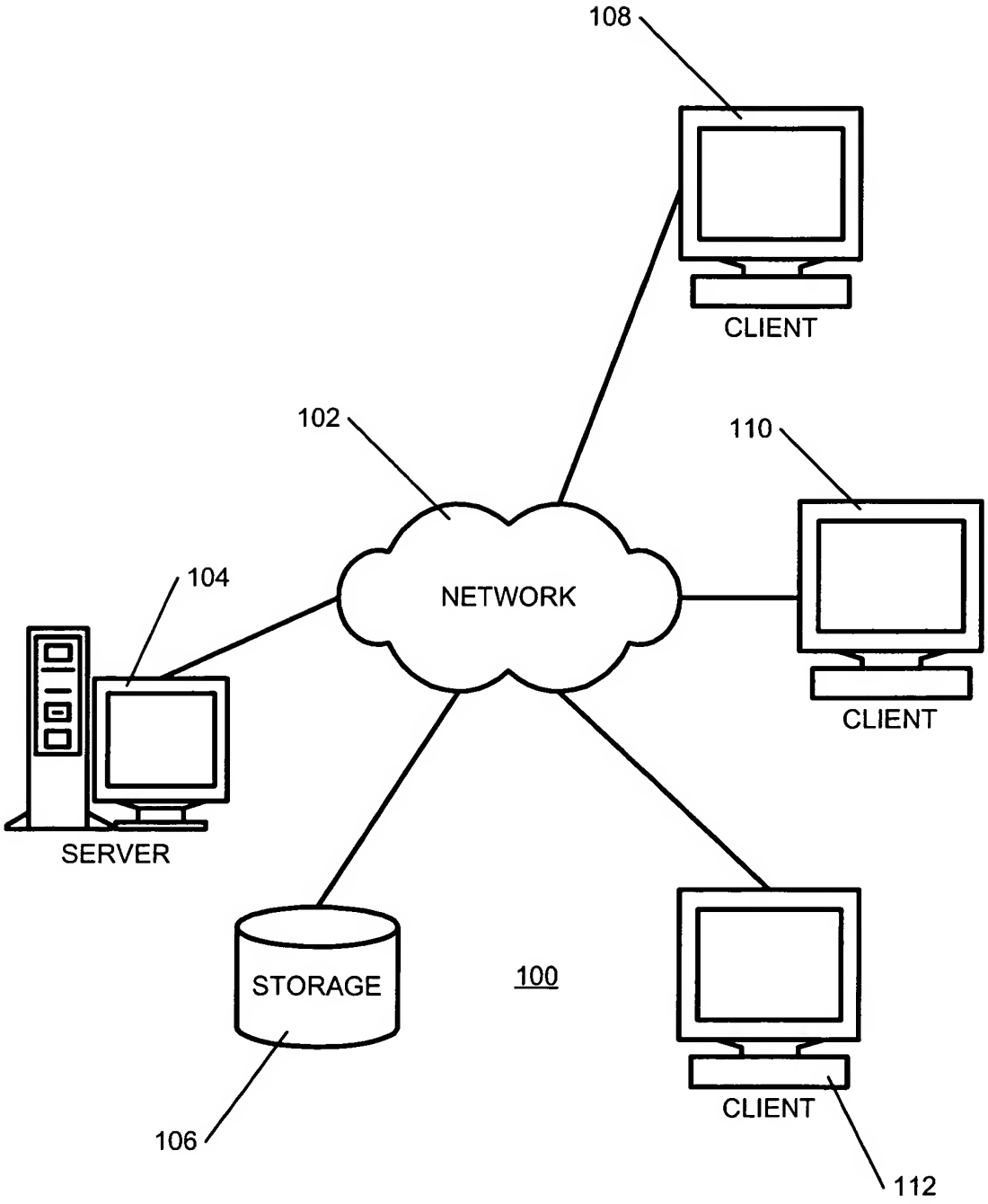
108
CLIENT
102
110
NETWORK
104
CLIENT
SERVER
STORAGE
100
CLIENT
106
112

FIG. 1

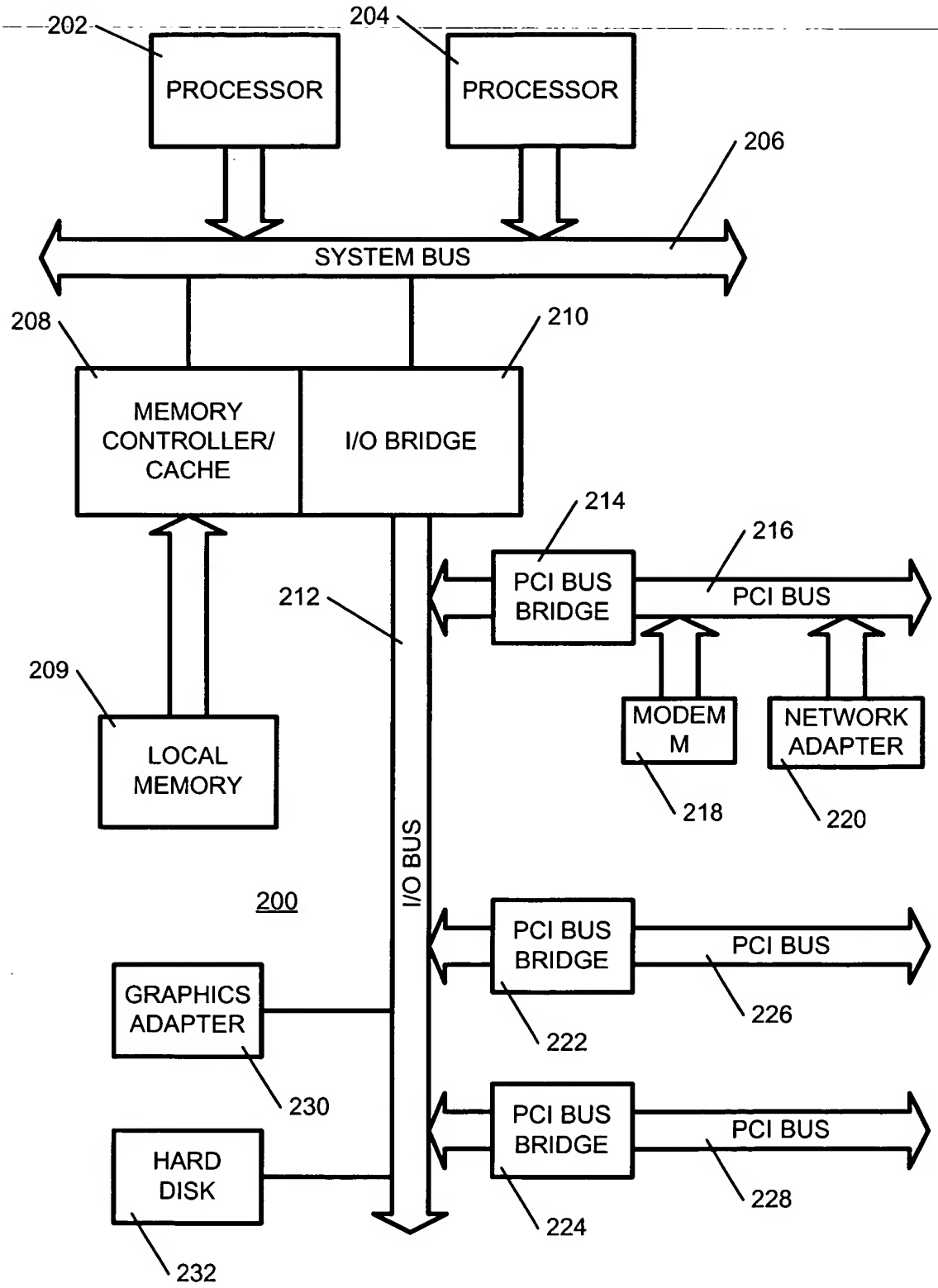
202
204
PROCESSOR
PROCESSOR
206
SYSTEM BUS
208
210
MEMORY CONTROLLER/ CACHE
I/O BRIDGE
214
216
PCI BUS BRIDGE
PCI BUS
212
209
LOCAL MEMORY
MODEM M
NETWORK ADAPTER
218
220
I/O BUS
200
PCI BUS BRIDGE
PCI BUS
GRAPHICS ADAPTER
222
226
230
PCI BUS BRIDGE
PCI BUS
HARD DISK
224
228
232

FIG. 2

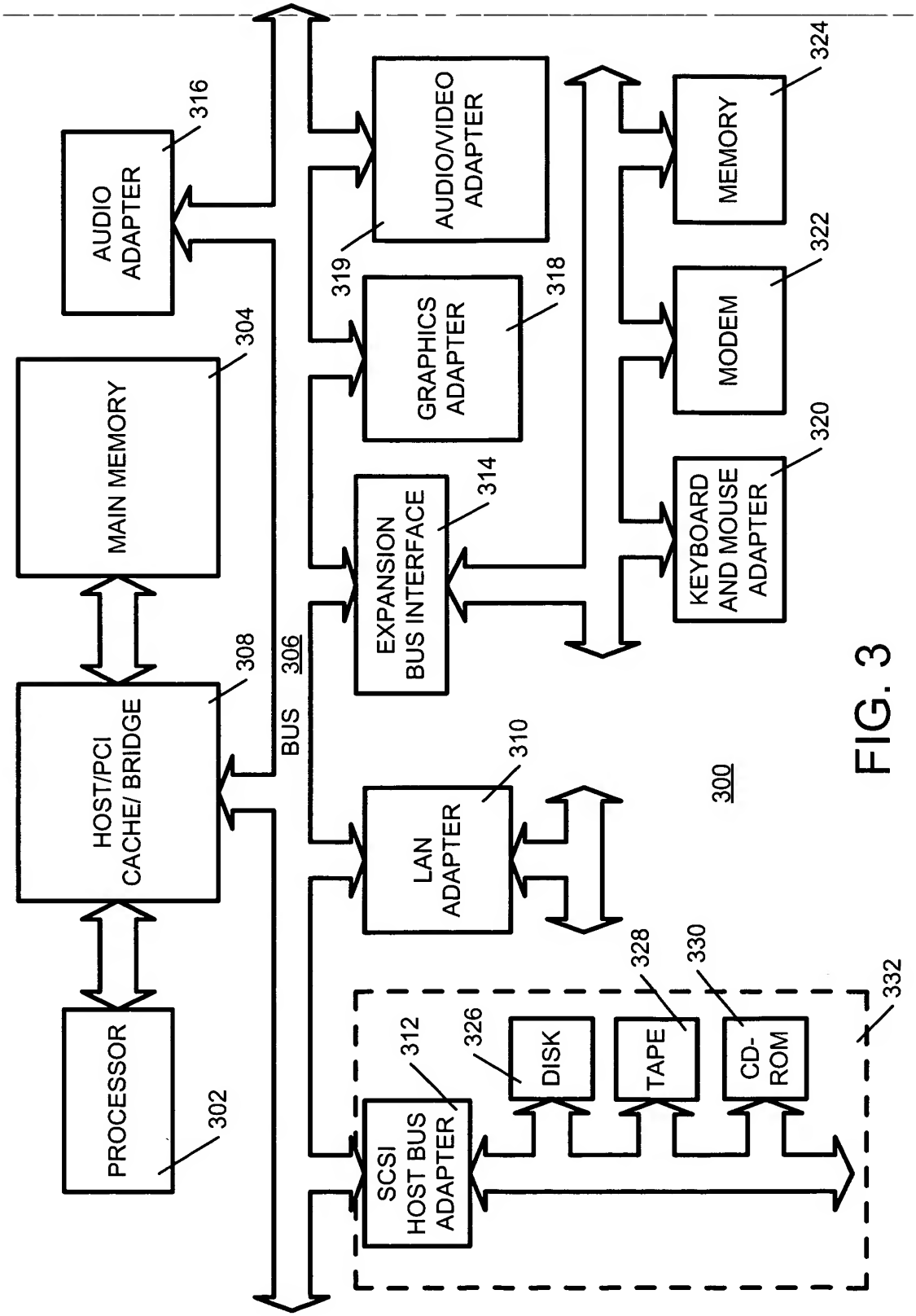
PROCESSOR
302
HOST/PCI CACHE/ BRIDGE
308
MAIN MEMORY
304
AUDIO ADAPTER
316
BUS
306
EXPANSION BUS INTERFACE
314
AUDIO/VIDEO ADAPTER
319
GRAPHICS ADAPTER
318
LAN ADAPTER
310
KEYBOARD AND MOUSE ADAPTER
320
MODEM
322
MEMORY
324
300
SCSI HOST BUS ADAPTER
312
DISK
326
TAPE
328
CD-ROM
330
332

FIG. 3

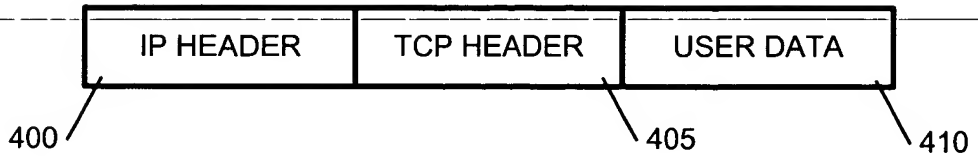
IP HEADER
TCP HEADER
USER DATA
400
405
410

FIG. 4

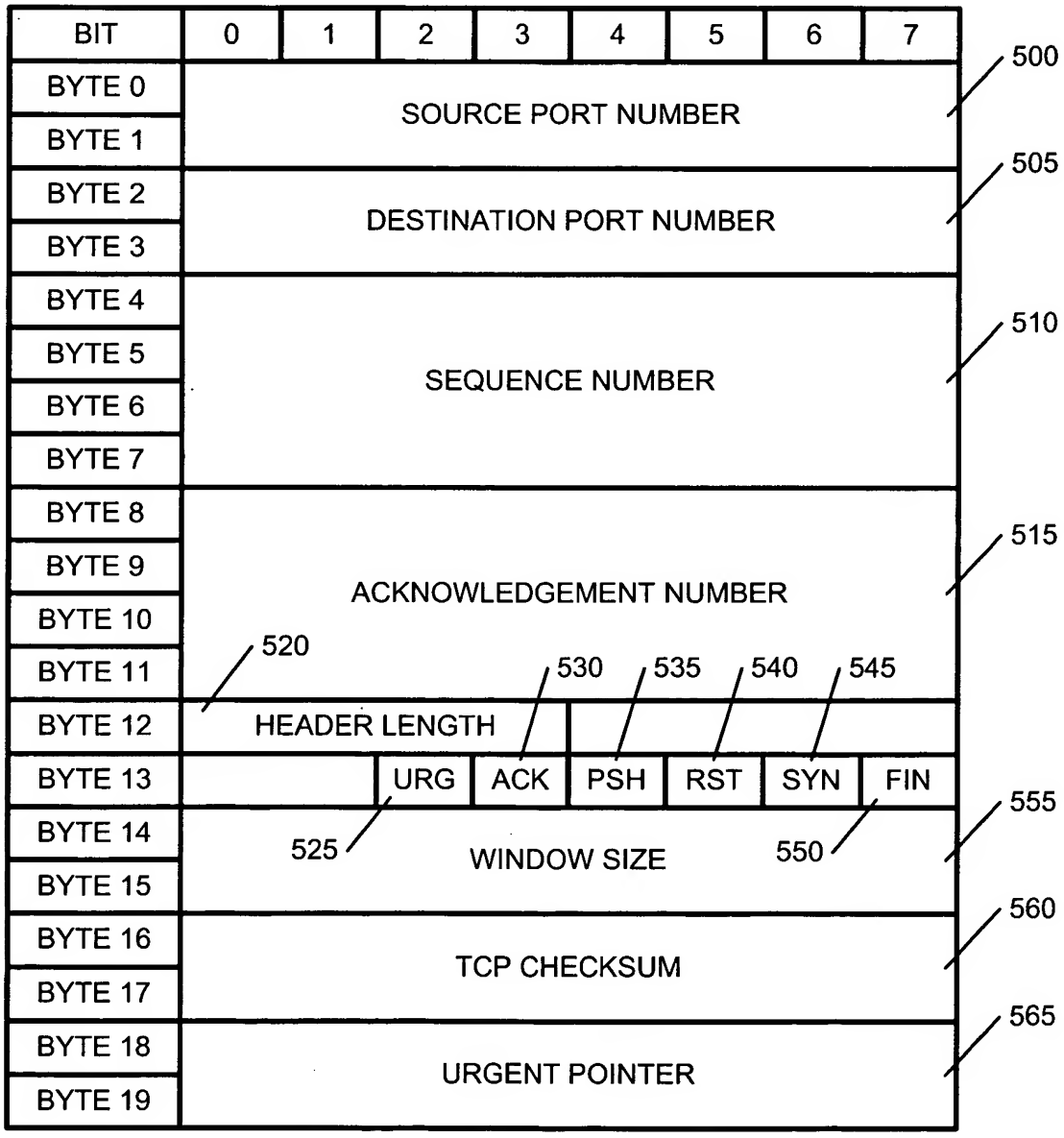
BIT
0
1
2
3
4
5
6
7
BYTE 0
BYTE 1
SOURCE PORT NUMBER
500
BYTE 2
BYTE 3
DESTINATION PORT NUMBER
505
BYTE 4
BYTE 5
BYTE 6
BYTE 7
SEQUENCE NUMBER
510
BYTE 8
BYTE 9
BYTE 10
BYTE 11
ACKNOWLEDGEMENT NUMBER
515
520
530
535
540
545
BYTE 12
HEADER LENGTH
BYTE 13
URG
ACK
PSH
RST
SYN
FIN
BYTE 14
BYTE 15
525
WINDOW SIZE
550
555
BYTE 16
BYTE 17
TCP CHECKSUM
560
BYTE 18
BYTE 19
URGENT POINTER
565

FIG. 5

```
<?XML VERSION="1.0"?>
<COMPANY NAME="INFORMATION STRATEGIES">
        <EMPLOYEES>
                <EMPLOYEE ID="1">HANK AARON</EMPLOYEE>
                <EMPLOYEE ID="2">BABE RUTH</EMPLOYEE>
        </EMPLOYEES>
</COMPANY>
```

FIG. 6

```
<EMPLOYEE ID="3">MICKEY MANTLE</EMPLOYEE>
<EMPLOYEE ID="4">TY COBB</EMPLOYEE>
```

FIG. 7

```
<?XML VERSION="1.0"?>
    <IP_HEADER>
     <TCP_HEADER>
      <TCP_CONNECTION>
            <SYN_SENT>SEQUENCE#</SYN_SENT>
            <SYN_RECEIVED>SEQUENCE#</SYN_RECEIVED>
            <ACK_RECEIVED>ACK#</ACK_RECEIVED>
            <ACK_SENT>ACK#</ACK_SENT>
      </TCP_CONNECTION>
     </TCP_HEADER>
    </IP_HEADER>
```

FIG. 8

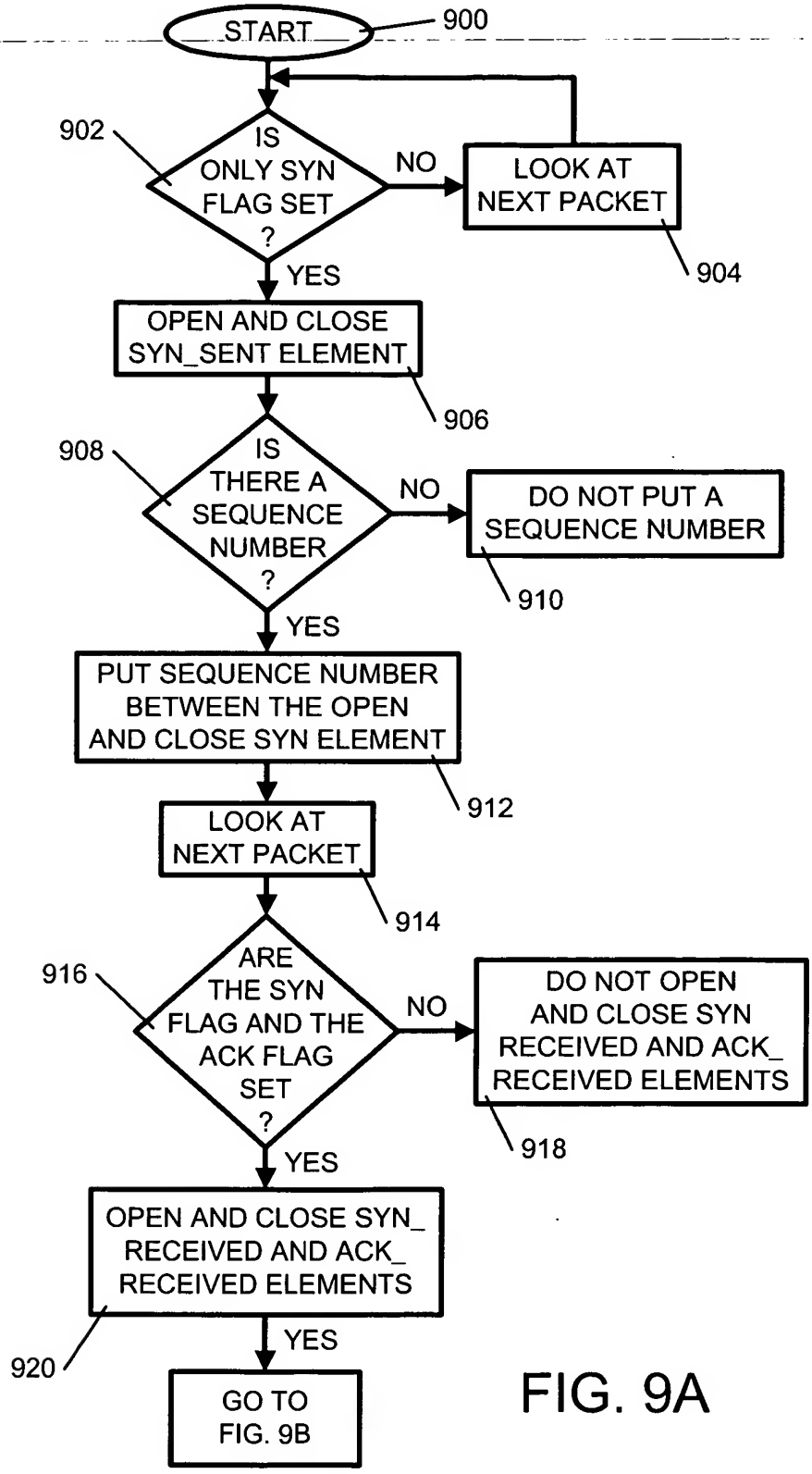
START
900
902
IS ONLY SYN FLAG SET ?
NO
LOOK AT NEXT PACKET
904
YES
OPEN AND CLOSE SYN_SENT ELEMENT
906
908
IS THERE A SEQUENCE NUMBER ?
NO
DO NOT PUT A SEQUENCE NUMBER
910
YES
PUT SEQUENCE NUMBER BETWEEN THE OPEN AND CLOSE SYN ELEMENT
912
LOOK AT NEXT PACKET
914
916
ARE THE SYN FLAG AND THE ACK FLAG SET ?
NO
DO NOT OPEN AND CLOSE SYN RECEIVED AND ACK_ RECEIVED ELEMENTS
918
YES
OPEN AND CLOSE SYN_ RECEIVED AND ACK_ RECEIVED ELEMENTS
920
YES
GO TO FIG. 9B

FIG. 9A

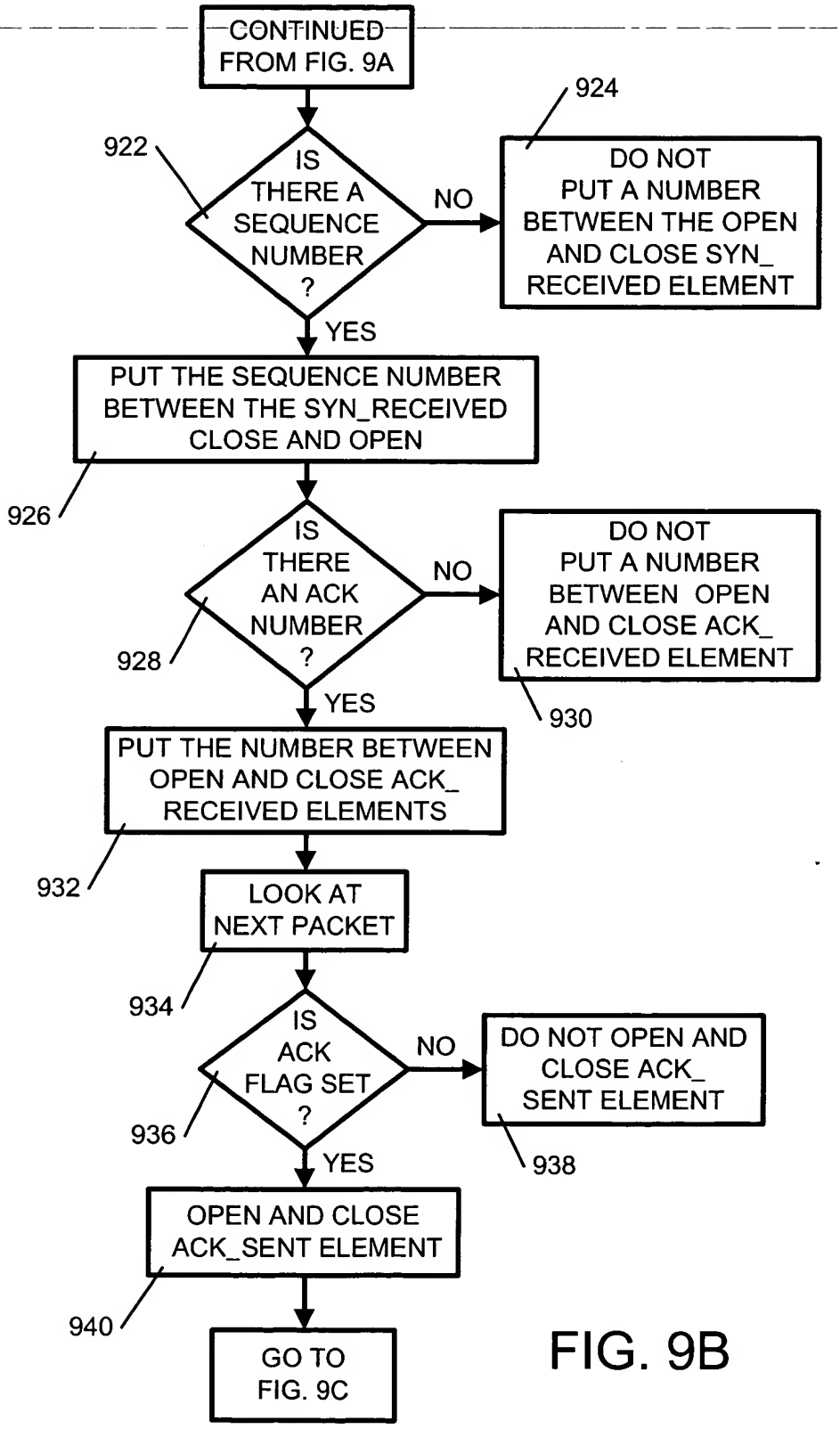
CONTINUED FROM FIG. 9A
922
IS THERE A SEQUENCE NUMBER ?
NO
924
DO NOT PUT A NUMBER BETWEEN THE OPEN AND CLOSE SYN_ RECEIVED ELEMENT
YES
PUT THE SEQUENCE NUMBER BETWEEN THE SYN_RECEIVED CLOSE AND OPEN
926
IS THERE AN ACK NUMBER ?
928
NO
DO NOT PUT A NUMBER BETWEEN OPEN AND CLOSE ACK_ RECEIVED ELEMENT
930
YES
PUT THE NUMBER BETWEEN OPEN AND CLOSE ACK_ RECEIVED ELEMENTS
932
LOOK AT NEXT PACKET
934
IS ACK FLAG SET ?
936
NO
DO NOT OPEN AND CLOSE ACK_ SENT ELEMENT
938
YES
OPEN AND CLOSE ACK_SENT ELEMENT
940
GO TO FIG. 9C

FIG. 9B

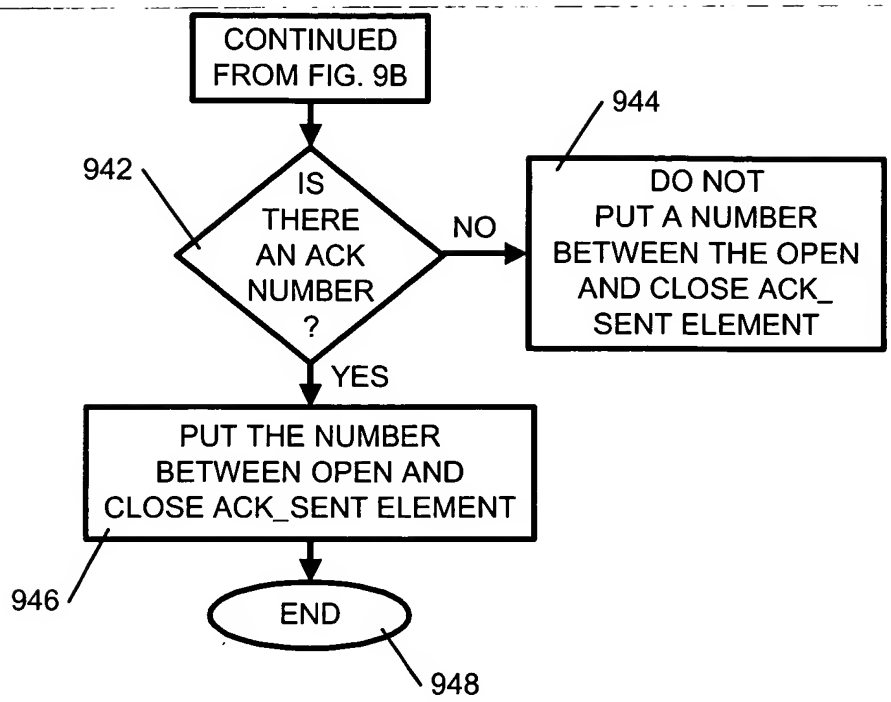
CONTINUED FROM FIG. 9B
942
IS THERE AN ACK NUMBER ?
NO
944
DO NOT PUT A NUMBER BETWEEN THE OPEN AND CLOSE ACK_ SENT ELEMENT
YES
PUT THE NUMBER BETWEEN OPEN AND CLOSE ACK_SENT ELEMENT
946
END
948

FIG. 9C

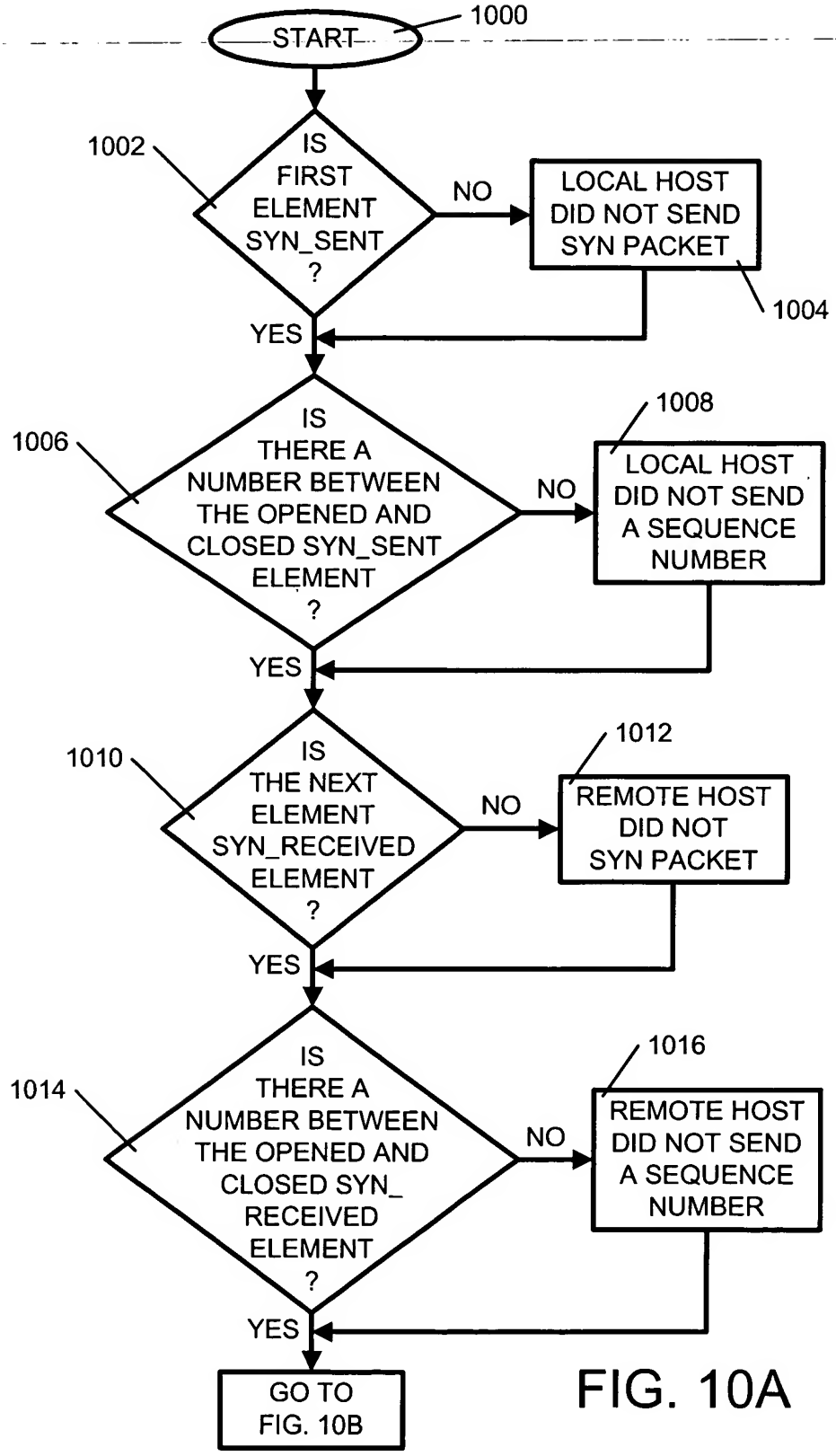
START
1000
IS FIRST ELEMENT SYN_SENT ?
1002
NO
LOCAL HOST DID NOT SEND SYN PACKET
1004
YES
IS THERE A NUMBER BETWEEN THE OPENED AND CLOSED SYN_SENT ELEMENT ?
1006
NO
1008
LOCAL HOST DID NOT SEND A SEQUENCE NUMBER
YES
IS THE NEXT ELEMENT SYN_RECEIVED ELEMENT ?
1010
NO
1012
REMOTE HOST DID NOT SYN PACKET
YES
IS THERE A NUMBER BETWEEN THE OPENED AND CLOSED SYN_ RECEIVED ELEMENT ?
1014
NO
1016
REMOTE HOST DID NOT SEND A SEQUENCE NUMBER
YES
GO TO FIG. 10B

FIG. 10A

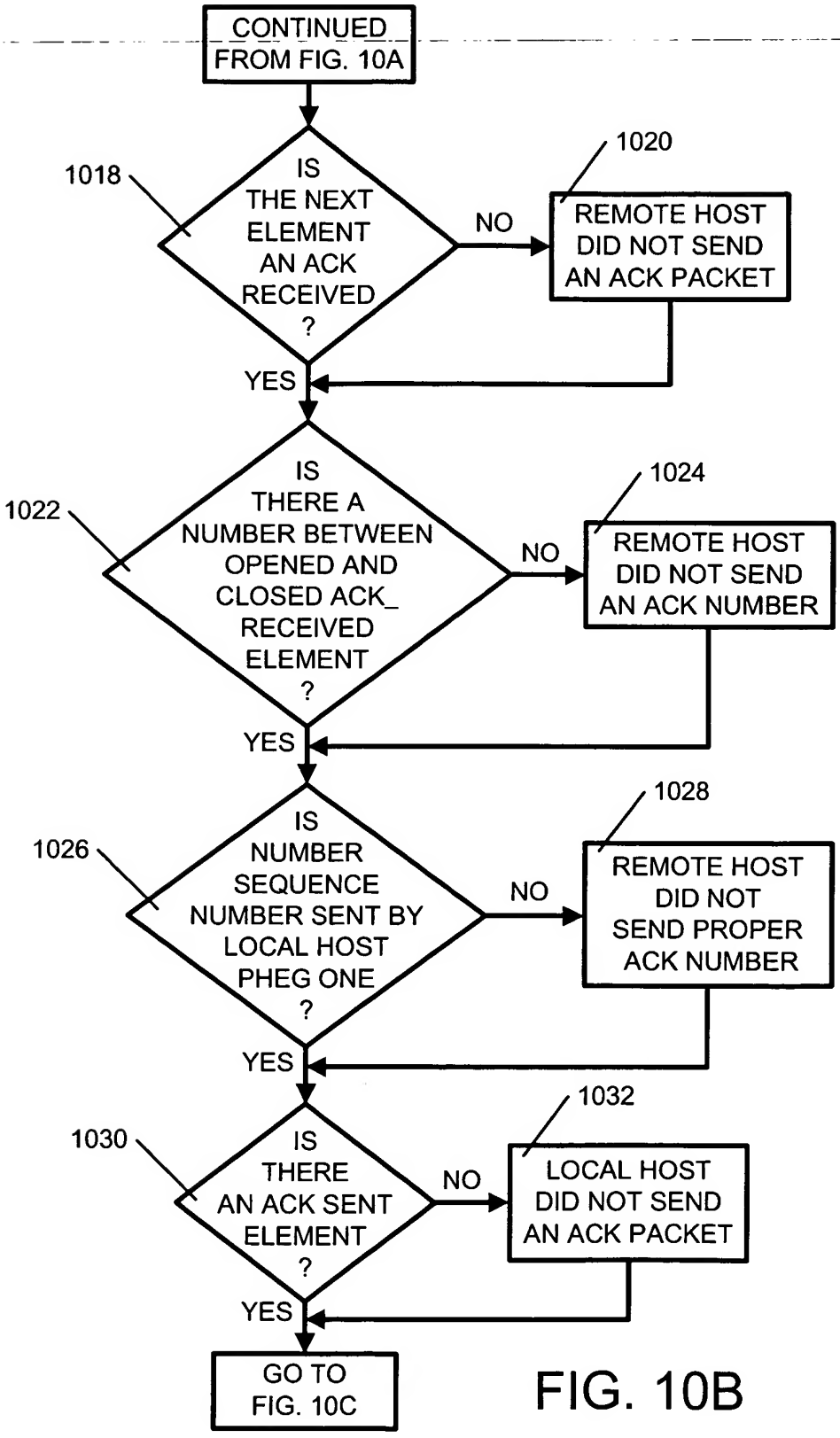
CONTINUED FROM FIG. 10A
1018
IS THE NEXT ELEMENT AN ACK RECEIVED ?
NO
1020
REMOTE HOST DID NOT SEND AN ACK PACKET
YES
1022
IS THERE A NUMBER BETWEEN OPENED AND CLOSED ACK_ RECEIVED ELEMENT ?
NO
1024
REMOTE HOST DID NOT SEND AN ACK NUMBER
YES
1026
IS NUMBER SEQUENCE NUMBER SENT BY LOCAL HOST PHEG ONE ?
NO
1028
REMOTE HOST DID NOT SEND PROPER ACK NUMBER
YES
1030
IS THERE AN ACK SENT ELEMENT ?
NO
1032
LOCAL HOST DID NOT SEND AN ACK PACKET
YES
GO TO FIG. 10C

FIG. 10B

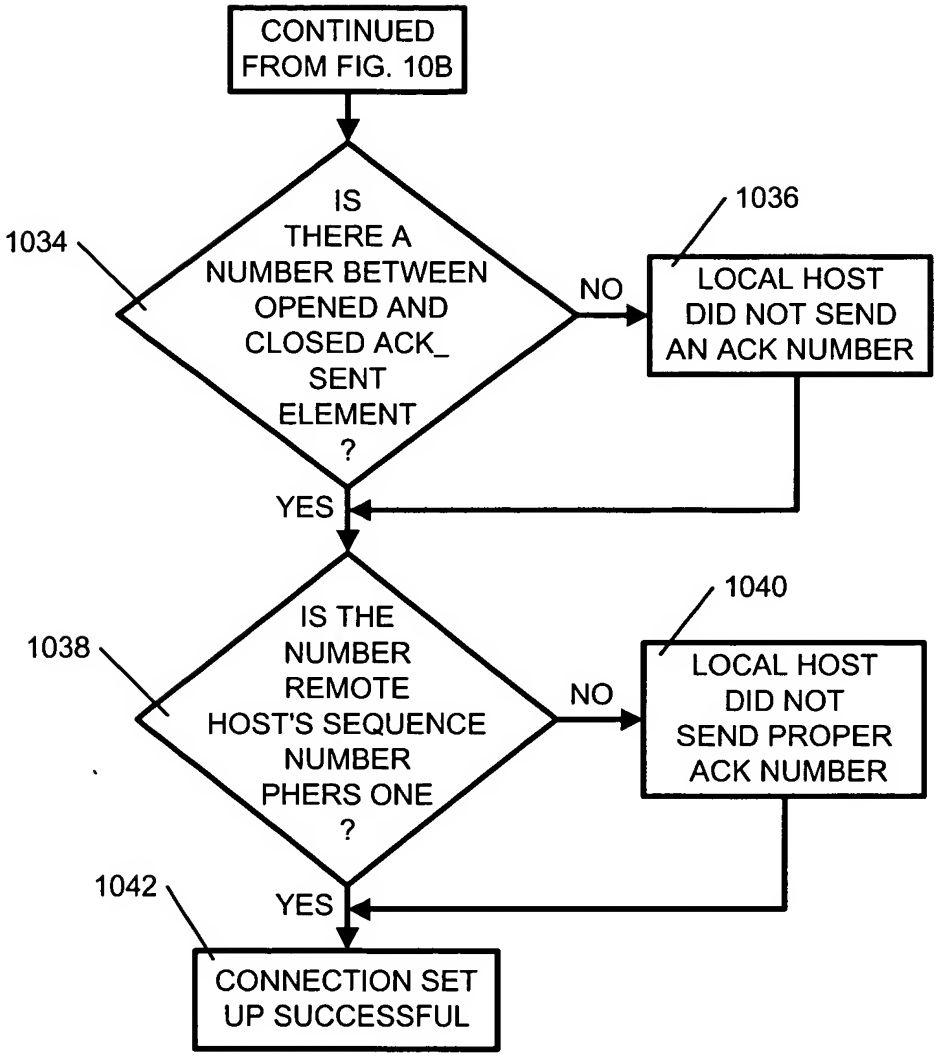
CONTINUED FROM FIG. 10B
IS THERE A NUMBER BETWEEN OPENED AND CLOSED ACK_ SENT ELEMENT ?
1034
NO
1036
LOCAL HOST DID NOT SEND AN ACK NUMBER
YES
IS THE NUMBER REMOTE HOST'S SEQUENCE NUMBER PHERS ONE ?
1038
NO
1040
LOCAL HOST DID NOT SEND PROPER ACK NUMBER
1042
YES
CONNECTION SET UP SUCCESSFUL

FIG. 10C

```
<?XML VERSION="1.0"?>
 <XS:SCHEMA XMLNS:XS="HTTP://WWW.W3.ORG/2001/XMLSCHEMA>
  <XS:ELEMENT NAME="IP_HEADER">
   <XS:COMPLEXTYPE>
    <XS:SEQUENCE>
     <XS:ELEMENT NAME="TCP_HEADER">
      <XS:COMPLEXTYPE>
       <XS:SEQUENCE>
        <XS:ELEMENT NAME="TCP_CONNECTION">
        <XS:COMPLEXTYPE>
         <XS:SEQUENCE>
          <XS:ELEMENT REF="SYN_SENT" MINOCCURS="0" MAXOCCURS="1"/>
          <XS:ELEMENT REF="SYN_RECEIVED" MINOCCURS="0"
                                MAXOCCURS="1"/>
          <XS:ELEMENT REF="ACK_RECEIVED" MINOCCURS="0"
                          MAXOCCURS="UNBOUNDED"/>
          <XS:ELEMENT REF="ACK_SENT" MINOCCURS="0" MAXOCCURS=
                                      "UNBOUNDED"/>

         </XS:SEQUENCE>
        </XS:COMPLEXTYPE>
       </XS:ELEMENT>
      </XS:SEQUENCE>
     </XS:COMPLEXTYPE>
    </XS:ELEMENT>
   </XS:SEQUENCE>
  </COMPLEXTYPE>
 </XS:ELEMENT>
</XS:SCHEMA>
```

FIG. 11

```
<?XML VERSION="1.0"?>
    <IP_HEADER>
     <TCP_HEADER>
        <TCP_CLOSE-CONNECTION
            <FIN_SENT>SEQUENCE#</FIN_SENT>
            <ACK_RECEIVED>ACK#</ACK_RECEIVED>
            <FIN_RECEIVED>SEQUENCE#</FIN_RECEIVED>
            <ACK_SENT>ACK#</ACK_SENT>
        </TCP_CLOSE-CONNECTION>
     </TCP_HEADER>
    </IP_HEADER>
```

FIG. 12

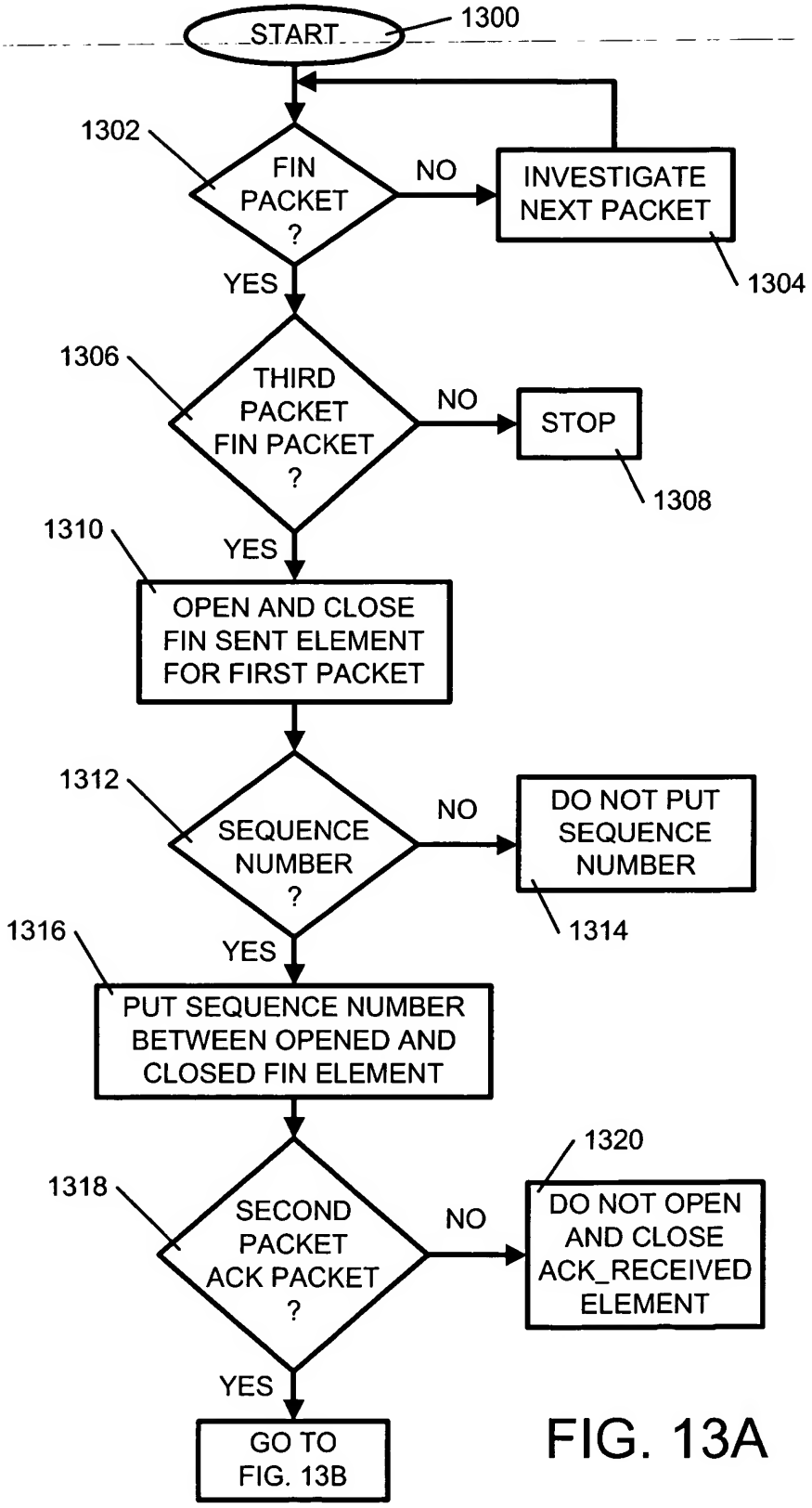
START
1300
1302
FIN PACKET ?
NO
INVESTIGATE NEXT PACKET
1304
YES
1306
THIRD PACKET FIN PACKET ?
NO
STOP
1308
YES
1310
OPEN AND CLOSE FIN SENT ELEMENT FOR FIRST PACKET
1312
SEQUENCE NUMBER ?
NO
DO NOT PUT SEQUENCE NUMBER
1314
YES
1316
PUT SEQUENCE NUMBER BETWEEN OPENED AND CLOSED FIN ELEMENT
1318
SECOND PACKET ACK PACKET ?
NO
1320
DO NOT OPEN AND CLOSE ACK_RECEIVED ELEMENT
YES
GO TO FIG. 13B

FIG. 13A

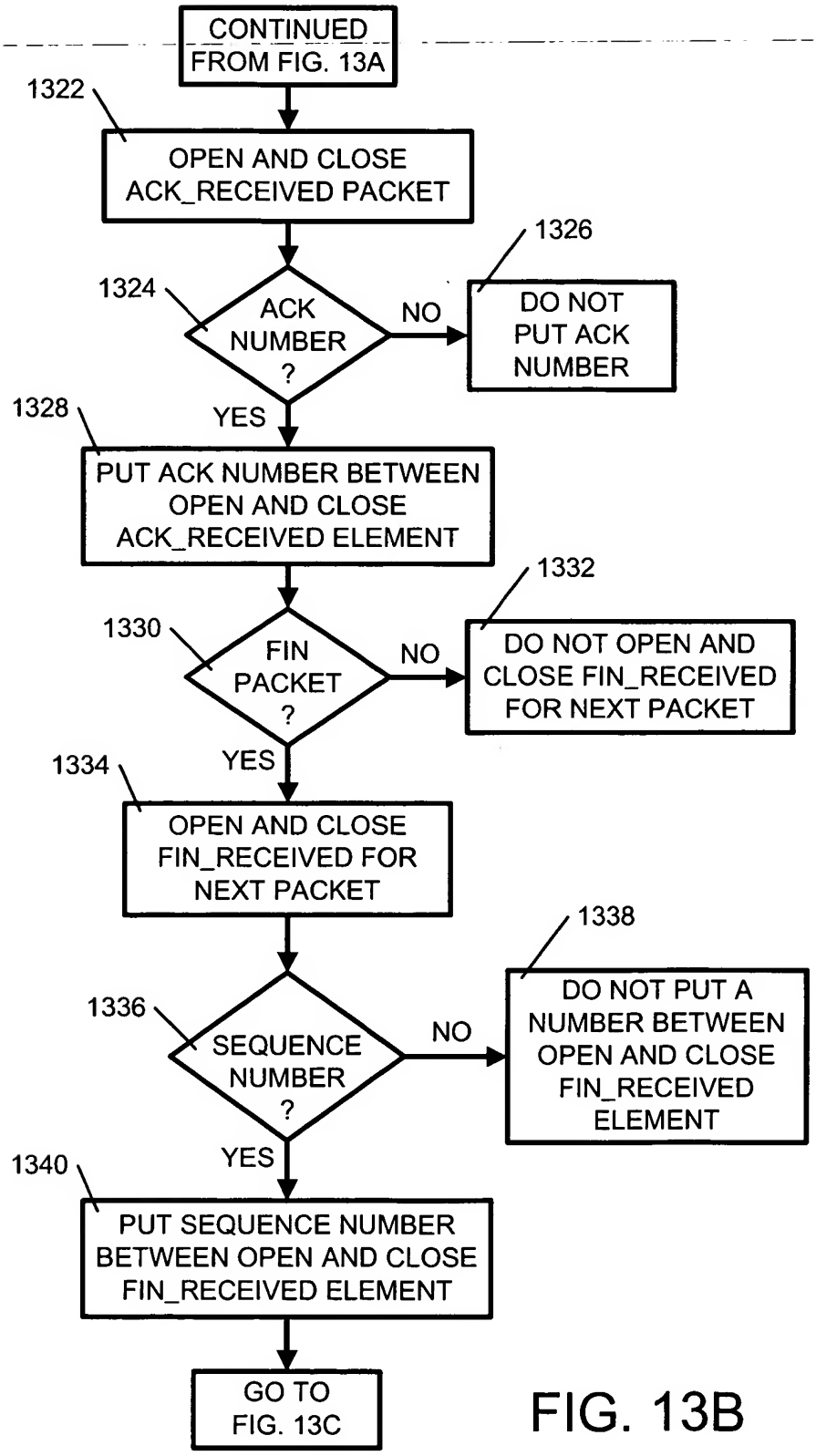
CONTINUED FROM FIG. 13A
1322
OPEN AND CLOSE ACK_RECEIVED PACKET
1324
ACK NUMBER ?
NO
1326
DO NOT PUT ACK NUMBER
YES
1328
PUT ACK NUMBER BETWEEN OPEN AND CLOSE ACK_RECEIVED ELEMENT
1330
FIN PACKET ?
NO
1332
DO NOT OPEN AND CLOSE FIN_RECEIVED FOR NEXT PACKET
YES
1334
OPEN AND CLOSE FIN_RECEIVED FOR NEXT PACKET
1336
SEQUENCE NUMBER ?
NO
1338
DO NOT PUT A NUMBER BETWEEN OPEN AND CLOSE FIN_RECEIVED ELEMENT
YES
1340
PUT SEQUENCE NUMBER BETWEEN OPEN AND CLOSE FIN_RECEIVED ELEMENT
GO TO FIG. 13C

FIG. 13B

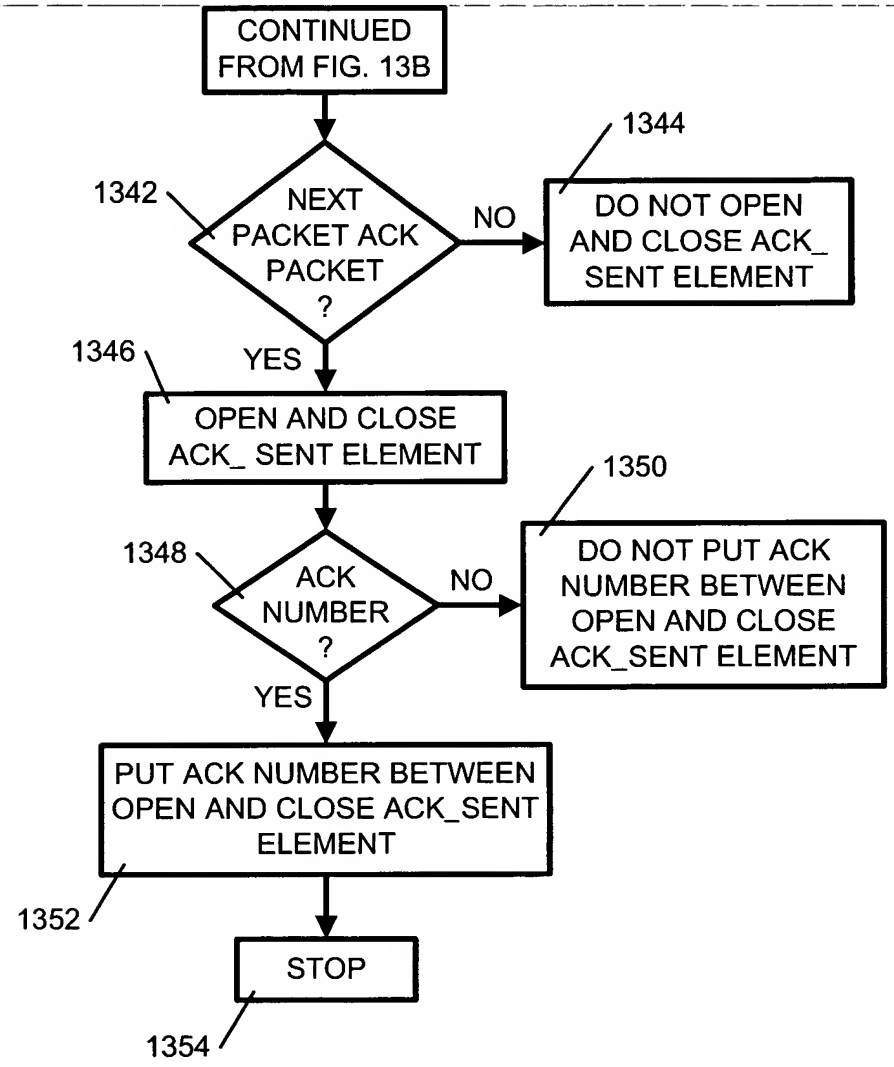
CONTINUED FROM FIG. 13B
1342
NEXT PACKET ACK PACKET ?
NO
1344
DO NOT OPEN AND CLOSE ACK_ SENT ELEMENT
YES
1346
OPEN AND CLOSE ACK_ SENT ELEMENT
1348
ACK NUMBER ?
NO
1350
DO NOT PUT ACK NUMBER BETWEEN OPEN AND CLOSE ACK_SENT ELEMENT
YES
PUT ACK NUMBER BETWEEN OPEN AND CLOSE ACK_SENT ELEMENT
1352
STOP
1354

FIG. 13C

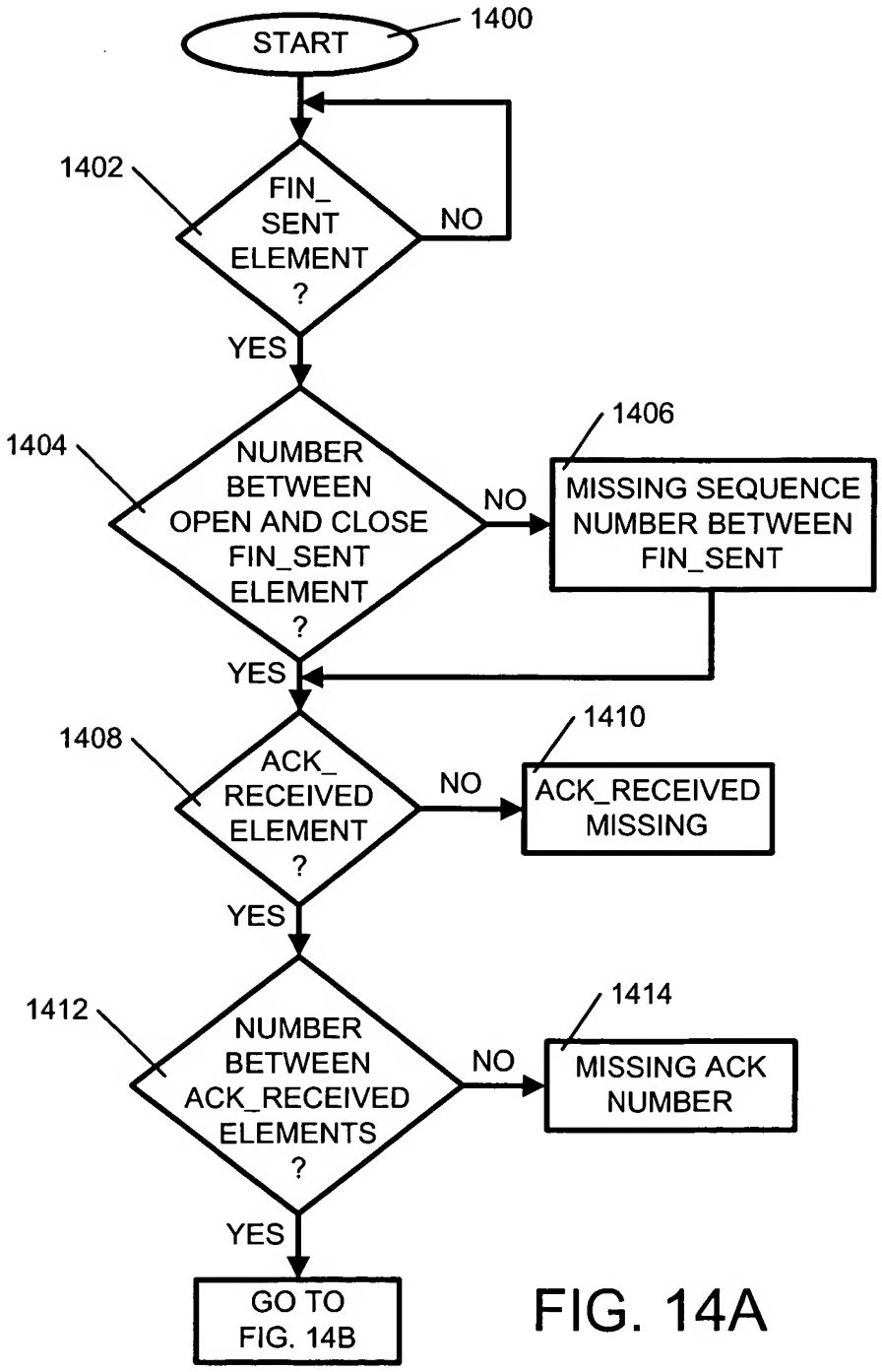
START
1400
1402
FIN_ SENT ELEMENT ?
NO
YES
1404
NUMBER BETWEEN OPEN AND CLOSE FIN_SENT ELEMENT ?
NO
1406
MISSING SEQUENCE NUMBER BETWEEN FIN_SENT
YES
1408
ACK_ RECEIVED ELEMENT ?
NO
1410
ACK_RECEIVED MISSING
YES
1412
NUMBER BETWEEN ACK_RECEIVED ELEMENTS ?
NO
1414
MISSING ACK NUMBER
YES
GO TO FIG. 14B

FIG. 14A

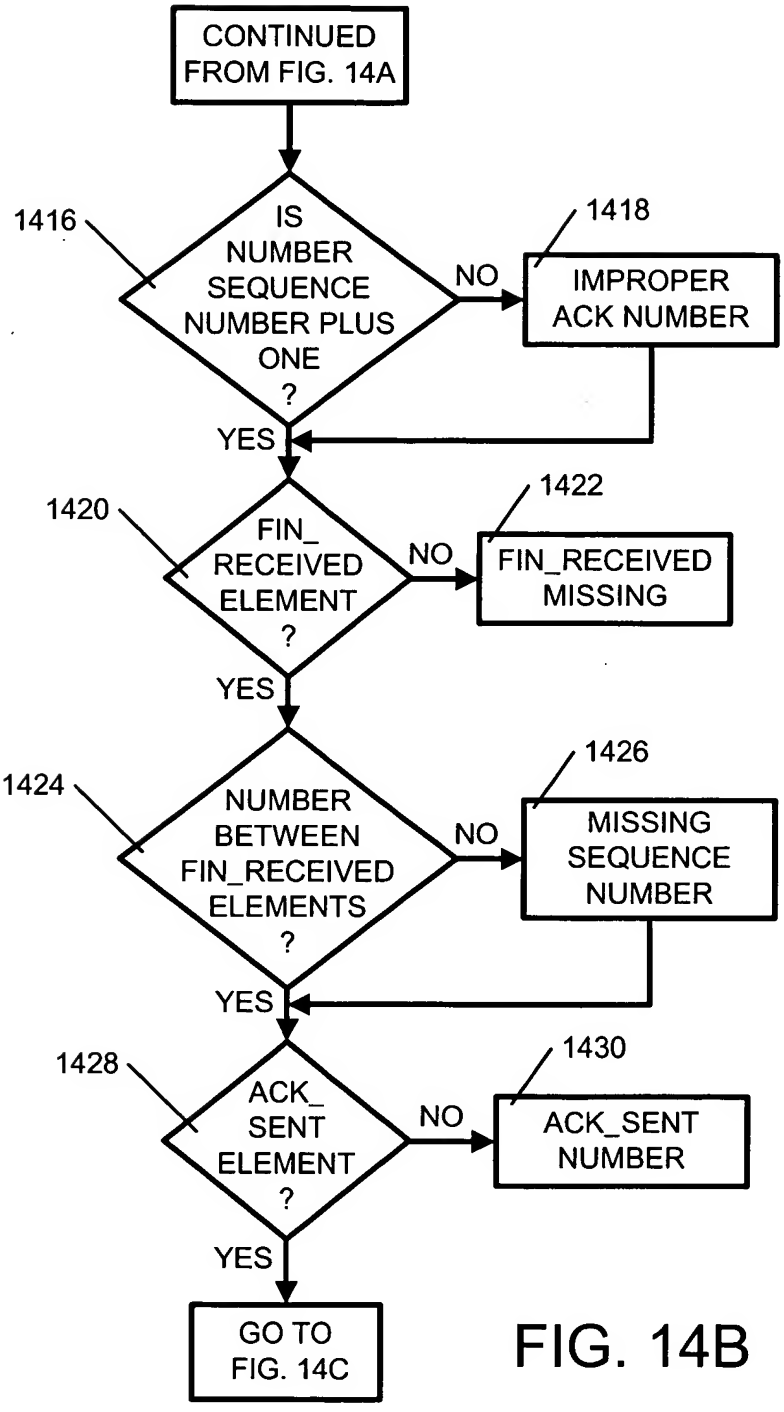
CONTINUED FROM FIG. 14A
1416
IS NUMBER SEQUENCE NUMBER PLUS ONE ?
NO
1418
IMPROPER ACK NUMBER
YES
1420
FIN_ RECEIVED ELEMENT ?
NO
1422
FIN_RECEIVED MISSING
YES
1424
NUMBER BETWEEN FIN_RECEIVED ELEMENTS ?
NO
1426
MISSING SEQUENCE NUMBER
YES
1428
ACK_ SENT ELEMENT ?
NO
1430
ACK_SENT NUMBER
YES
GO TO FIG. 14C

FIG. 14B

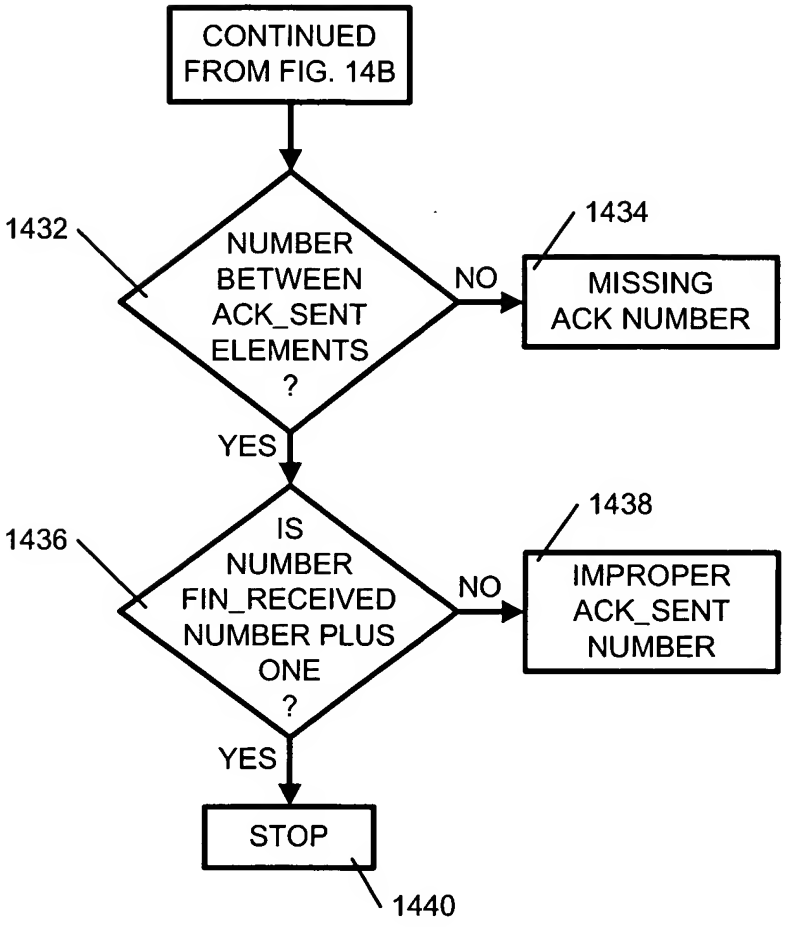
CONTINUED FROM FIG. 14B
1432
NUMBER BETWEEN ACK_SENT ELEMENTS ?
NO
1434
MISSING ACK NUMBER
YES
1436
IS NUMBER FIN_RECEIVED NUMBER PLUS ONE ?
NO
1438
IMPROPER ACK_SENT NUMBER
YES
STOP
1440

FIG. 14C

```
<?XML VERSION="1.0"?>
 <XS:SCHEMA XMLNS:XS="HTTP://WWW.W3.ORG/2001/XMLSCHEMA>
  <XS:ELEMENT NAME="IP_HEADER">
   <XS:COMPLEXTYPE>
    <XS:SEQUENCE>
     <XS:ELEMENT NAME="TCP_HEADER">
      <XS:COMPLEXTYPE>
       <XS:SEQUENCE>
        <XS:ELEMENT NAME="TCP_CLOSE-CONNECTION">
         <XS:COMPLEXTYPE>
         <XS:SEQUENCE>
          <XS:ELEMENT REF="FIN_SENT" MINOCCURS="0"
                    MAXOCCURS="UNBOUNDED"/>
          <XS:ELEMENT REF="ACK_RECEIVED" MINOCCURS="0"
                     MAXOCCURS="UNBOUNDED"/>
          <XS:ELEMENT REF="FIN_RECEIVED" MINOCCURS="0"
                    MAXOCCURS="UNBOUNDED"/>
          <XS:ELEMENT REF="ACK_SENT" MINOCCURS="0" MAXOCCURS=
                                    "UNBOUNDED"/>

         </XS:SEQUENCE>
        </XS:COMPLEXTYPE>
       </XS:ELEMENT>
      </XS:SEQUENCE>
     </XS:COMPLEXTYPE>
    </XS:ELEMENT>
   </XS:SEQUENCE>
  </XS:COMPLEXTYPE>
 </XS:ELEMENT>
</XS:SCHEMA>
```

FIG. 15

```
GIL.1023>DEVO.LOGIN:S 768512(0) WIN 4096 <MSS 1024>
DEVO.LOGIN>GIL.1023:S 947648:947648(0) ACK 768513 WIN 4096 <MSS 1024>
GIL.1023>DEVO.LOGIN: .ACK 1 WIN 4096
```

FIG. 16

```
<?XML VERSION="1.0"?>
<IP_HEADER>
  <TCP_HEADER APP="RLOGIN" SPORT="1023" SHOST="GIL" RPORT="LOGIN"
  RHOST="DEVO">
   <TCP_CONNECTION>
       <SYN_SENT WIN="4096" MSS="1024>768512:768512(0) </SYN_SENT>
       <SYN_RECEIVED WIN="4096" MSS="1024">947648:947648(0)
       </SYN_RECEIVED>
       <ACK__RECEIVED WIN="4096" MSS="1024">768513
       </ACK_RECEIVED>
       <ACK_SENT WIN="4096 RELATIVESEQ="YES">1
       </ACK_SENT>
   </TCP_CONNECTION>
  </TCP_HEADER>
</IP_HEADER>
```

FIG. 17

```
<CONNECTION_ESTABLISH>
            <PARAMETER_NEGOTIATION>
            <DATA_EXCHANGE>
            ...
            <WINDUP_OPERATIONS>
<CONNECTION_CLOSE>
```

FIG. 18

```
<?XML VERSION="1.0"?>
<IP_HEADER>
  <TCP_HEADER >
       <SYN_RECEIVED>SEQUENCE# </SYN_RECEIVED>
       <SYN_SENT>SEQUENCE#</SYN_SENT>
       <ACK_RECEIVED>ACK#</ACK RECEIVED>
       <ACK__SENT>ACK#</ACK_SENT>
  </TCP_HEADER>
</IP_HEADER>
```

FIG. 19

```
<?XML VERSION="1.0"?>
<IP_HEADER>
  <TCP_HEADER >
       <SYN_RECEIVED>SEQUENCE# </SYN_RECEIVED>
       <ACK_RECEIVED>ACK#</ACK RECEIVED>
       <ACK__SENT>ACK#</ACK_SENT>
  </TCP_HEADER>
</IP_HEADER>
```

FIG. 20